elusive, although the perusal of this monograph may bring another investigation a little closer to that objective.

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Subjective Phenomena

Image Formation and Cognition. MARDI JON HOROWITZ. Appleton-Century-Crofts, New York, 1970. xvi, 352 pp., illus. $12.50.

The psychology of cognition has undergone some major reorientations in the last five to ten years, and this book is an important and timely contribution to that active field. Mental imaging—the subjective equivalent of looking and listening—has its equivalents for such experiences as taste, smell, touch, and pain, and images of these various kinds play an important part in thinking, remembering, and fantasy, all concerns of the cognitive psychologist. Horowitz, writing as a psychiatrist, shows imagery to be important also in the practical sphere of dealing with patients, and examines its various forms in their relation to symptoms, treatment, and prognosis.

A new and original examination of the problem of classifying the various phenomena of imagery begins the book. Horowitz deals ably with hallucinations, dreams, and the half-awake (hypnagogic) state and the strange intrusions of dreamlike imagery that some people experience while falling asleep. He discusses the body image—the conception a person has of his own body as a spatial object and of its shape, position, and orientation to surroundings—and offers interesting clinical evidence of disturbances of the body image that may occur in the hypnagogic state or under drug or anesthetic influence. Other phenomena dealt with are synesthesia, with its intersensory blendings of imagery and perception (such as the shape and color imagery some people have on hearing music); "flashbacks" (reexperienced images after drug-induced states); "dream scintillations" (successions of images that intrude in full wakefulness); and *déjá vu*. There is an up-to-date account of experiments involving sensory deprivation and hallucinogenic drugs, and a strong chapter on the influence of the brain in image formation.

Some basically important issues about differences in imagery arise in relation to work with psychiatric patients. For example, it might be assumed that the psychotic patient with auditory hallucination is in other ways primarily an auditory imager. Horowitz shows that the opposite is probably the case; his discussion recalled a low-powered visual imager, not a patient, who once said to the present reviewer, "I've had visual images once or twice, and they nearly frightened me out of my wits." In the wide variations of imagery within the realm of the normal we can find much to comfort the anxious parent, and the author is alert to this need. This book should be read by those psychologists who remain even today introspectively illiterate because of the shadow of an out-of-date form of behaviorism that proscribed introspection; by psychiatrists who wish to understand more of the psychology of imagery and perception; and by those lay to both disciplines who wish to learn more about the subjective mental life of their spouses, their children, and themselves. Differences between individuals can be considerable.

Some minor criticisms may be made of this important and otherwise scholarly book. There is on occasion a hint of resort to the use of imaginary examples; these (known to psychologists as "fantastic anecdotes") are dangerous in exposition and irrelevant to proof. One leading English investigator of such phenomena as synesthesia, Magdalene D. Vernon (p. 70), would doubtless prefer to be cited as "she" rather than "he." Investigators from the side of psychology may be cautious about whether phenomena reported by Iskower, and heavily loaded with theoretical interpretation of a psychoanalytic kind, justify the status given them by the label "the Isakower phenomenon." Finally, it seems a pity that an investigator of the author's caliber should make use of that esthetically barbarous and linguistically impossible term "psychedelic," whose unfortunate associations have often embarrassed rather than helped serious research on the effects of hallucinogenic drugs on imagery.

These are very trivial criticisms, of a comma-spotting kind. The book is an absorbing one, distinguished by originality, theoretical reorientation, and valid inference in relation to available evidence. After a first reading, the reviewer had to borrow it back repeatedly from colleagues working in the same field who proved deeply interested in the intellectual news it contains. He awaits the author's next book with more than usual impatience.

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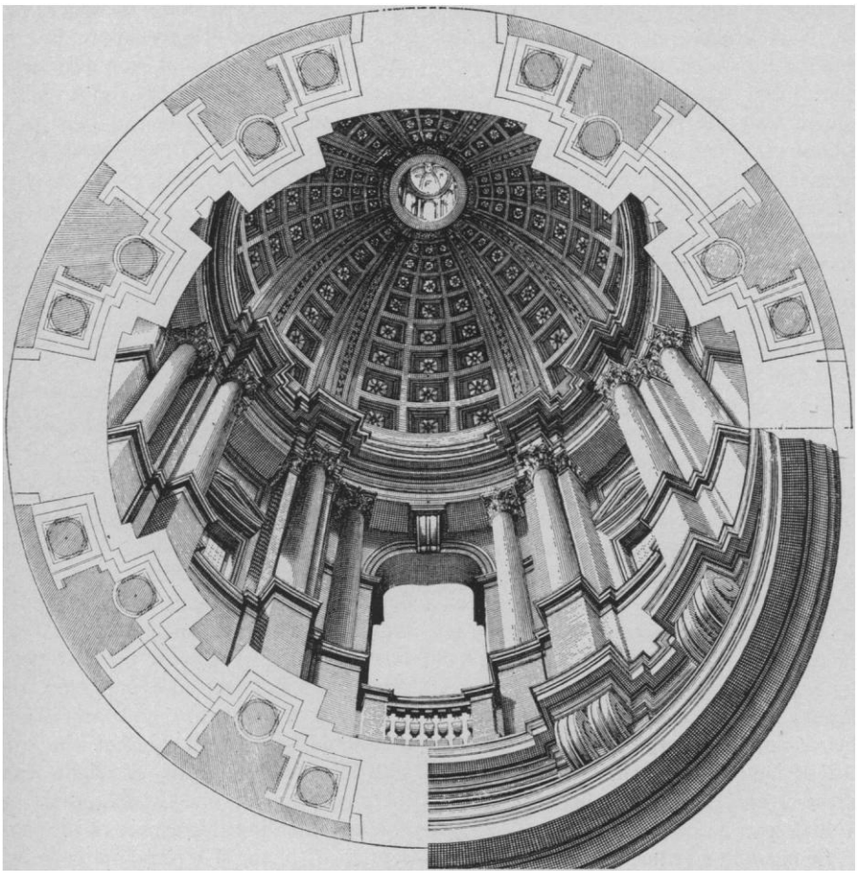
Perception and Depiction

Optics, Painting, and Photography. M. H. PIRENNE. Cambridge University Press, New York, 1970. xxiv, 200 pp., illus. $13.50.

Artists, experimental psychologists, and philosophers have long been concerned with the puzzling fact that a flat object (a picture) can in some sense substitute for an arrangement of very different objects in three dimensions. As a first step in explanation, we note that any picture and any tridimensional scene that present the eye with the same array of light can thereby substitute one for the other.

Understanding this aspect of the perception of pictorial representation rests, therefore, on some knowledge of physical and anatomical optics. The first seven chapters (about half) of Pirenne's book examine the anatomy of the eye and the geometry of image formation; a discussion of light, linear perspective, and central projection culminates in a description of the painted ceiling of the nave of St. Ignazio. In this painting, Pozzo's painstaking use of the geometry of central projection presents to the eye of an observer, if he stands at one particular point on the floor, an array that is almost identical to that which would have been produced if the church had an additional story with a much higher ceiling and with figures floating in midair. From that viewing point, reportedly, a nearly perfect *trompe l'oeil* is achieved. From off-center viewing points, the depicted scene reportedly appears deformed (nonrectangular), just as one would expect, because the array of light then reaching the eye is what it would receive from the distorted tridimensional arrangement.

Such perceived distortions in a depicted scene should, according to this principle, occur whenever the picture is viewed from any position other than the central projection point: The perspective picture of an object is itself



Engraving by Pozzo of a painting he made on a flat, circular ceiling in the middle of the transept of St. Ignazio. A cupola intended for this portion of the church was never actually built, but from below the painting produces an "irresistible illusion" of three-dimensionality. The painting of the ceiling of the nave (see review) was a more intricate optical problem, not only because the scenes represented were much more complicated but because the ceiling itself was hemicylindrical. [Reproduced in *Optics, Painting, and Photography* from the English edition (1707) of Pozzo's *Perspectiva Pictorum et Architectorum* (1693)]

an object, whose projection to our eye obeys the laws of perspective, and there is only one viewing position from which the picture will form a retinal image coincident with that produced by the pictured object. But as Pirenne points out, pictures are rarely viewed from the projection center and yet they do not therefore appear distorted. The remainder of the book is largely a discussion of why such distortions do not occur.

Pirenne argues that normal picture perception (as opposed to *trompe l'oeil* illusions) depends on the fact that we are aware of the picture not only as a represented scene but also as a flat patterned surface (because of the picture frame, the texture of the brush strokes, binocular vision, and so forth), and that our awareness of the orientation of the surface enables us to compensate for changed viewing positions. No specific explanations of this compensation are proposed. Pirenne does point out, however, that adherence to perspective projection often produces patterns on the flat picture plane that are unlike the object or the scene being represented (for example, off the principal point, spheres project as ellipses; and parallel lines at an angle to the picture plane project as nonparallel). When viewed from the proper station point, such pictures will, of course, produce the same image at the eye as does the scene itself and will appear undistorted, but Pirenne says that (unlike the pictures we commonly encounter) they do indeed look deformed to off-center viewing. He shows that artists tend therefore to depart from precise perspective, by presenting certain objects (especially familiar ones) as though their main surfaces were always parallel to the picture plane—as they would appear to frontal viewing—regardless of the object's depicted orientation. Thus, because the artist has predigested the scene, the spectator need only compensate for the slant of the picture plane in order to have compensated as well for the slant of the represented objects' surfaces, and the distinction between "representational" and "abstract" painting dissolves.

Throughout the book, the presentation is remarkably lucid but somewhat unsystematic in its conceptual progression. Very little technical knowledge is required to read the book, and Pirenne hopes that it will therefore be "of some use to those whose business it is to make representational pictures." It is not clear how it can be so used. The book is by no means a textbook on how to depict objects in space; indeed, such a textbook could not be written in our present state of knowledge. Although Pirenne reports several experiments, these are all demonstrations of the optics of perspective projection. His conclusions about the central questions of what people perceive still rest on anecdote and on casual observation. Thus we do not know to what degree spectators are really unable to distinguish illusion from reality in Pozzo's ceiling, or whether the distortions perceived in off-center viewing are what they should be in terms of central projection. In fact it is only conjecture that the spectator's perception of the picture's surface is causally implicated in whatever immunity to deformation appears in normal picture perception. We do not know to what degree the distortions are perceived but are merely not attended, or whether the supposed compensation actually rests on the spectator's apprehension of the picture's surface (pictorial compensation might be an example of what psychologists call slant-shape invariance, and might in that case be an unmediated response to the ratios of textural units subtended by the different parts of any surface-shape at a slant to the line of sight, as Gibson proposed in 1950).

But Pirenne has raised extremely important problems. If his conclusions survive experimental scrutiny (and my guess is that they will), they will go a long way toward making the study of representational painting a tool for inquiry into the function of the human cognitive system, and not merely a trivial application of geometrical optics.

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